and storm-tide characteristics, and the nature of the coast's response to specific storm systems. The Hatteras compartment faces northeast to east and receives the head-on impact of frequent nor'easters. In contrast, the Raleigh Bay compartment is generally southeast-facing and only receives glancing blows from powerful nor'easters. The Onslow Bay compartment faces south to southeast and the Long Bay compartment faces south. These orientations result in offshore winds and waves during nor'easters, but onshore seas from the dominant southwesterly winds during the summer and a high proportion of direct hits from less frequent, but higher energy tropical storms and hurricanes.

Estuaries and Barrier Islands

The drainage basins of North Carolina form a vast and complex network of creeks, streams, and rivers that move surface water off the uplands of the Blue Ridge, Piedmont, and Coastal Plain provinces to the Atlantic Ocean. The estuaries formed when rising sea level flooded up the valleys of these drainage systems, while the higher inter-stream divides formed low upland regions (Riggs and Ames, 2003).

Estuaries act as great mixing basins where the interplay between fresh and saline water, together with the regularity of astronomical tides and irregularity of wind tides, largely determines the coastal plant communities within the estuarine system. These, in turn, determine the type and distribution of shorelines (Riggs and Ames, 2003). As barrier-island inlets open, migrate, and close through time, chemical and physical conditions in the estuaries also change, resulting in major shifts in estuarine ecosystems.

Fronting the estuarine zone is a narrow strip of barrier islands that acts as a dam between the estuaries and ocean (Fig. 1). The sand islands, produced at sea level by the interaction of high-energy ocean storms with the paleo-topography of the gently sloping Coastal Plain, are broken by a series of small openings called "inlets" that allow the mixing of ocean water with riverine water (Fig. 1). Only a small portion of the barrier islands rises above the sea surface; the greater portion lies hidden below sea level. The sub-aerial portion of barrier islands is perched at the top of the shoreface, which slopes steeply to between 25 to 75 feet below sea level, where it flattens out onto the inner continental shelf. The shoreface ramp is the portion of a barrier island that functions as an important energy-absorbing surface for wave, tide, and current energy.

Barrier islands form and persist at the energetic interface between the land, sea, and air in response to four physical criteria: the presence of a gently sloping coastal plain-continental shelf, availability of adequate sediment, sea level, and the occurrence of high energy oceanic storms that build the islands and maintain them through time. Consequently, barrier islands are not only built by storm-dominated processes of inlet and overwash dynamics, but also act as critical energy-absorbing buffers at the land-sea-air interface. During times of rising sea level, storm dynamics constitute the process by which landward barrier island migration occurs.